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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/553,997	04/20/2000	Douglas A. Buchanan	13322(YOR92000-0036US1)	5913

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EXAMINER

ROSE, KIESHA L

ART UNIT PAPER NUMBER

2822

DATE MAILED: 06/18/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/553,997

Applicant(s)

BUCHANAN ET AL.

Examiner

Kiesha L. Rose

Art Unit

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1,2,4-12,14-22 and 24-57 is/are pending in the application.
- 4a) Of the above claim(s) 4-12 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1,2,14-22 and 24-57 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |   |  |
|---|--|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. ____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                  | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)            |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date ____ | 6) <input type="checkbox"/> Other: ____  |

## **DETAILED ACTION**

### ***Election/Restrictions***

The Office Action is in response to the amendment filed on January 20, 2004. Claims 1,2,4-12, 14-22, 24-57 are pending, claims 4-12 are withdrawn from consideration under 37 CFR 1.142(b). Election was made without traverse in Paper No. 10. The examiner requested cancellation of claims 4-12 in an interview on May 14, 2004; however, because the other claims are not in condition for allowance, the withdrawn claims were not cancelled and remain withdrawn from consideration.

### ***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1,2, 14-22, 24-26, 28-32 and 39-40 are rejected under 35 U.S.C. 102(e) as being anticipated by Marsh (U.S. Patent 6,541,067).

Claims 1-2 Marsh teaches a precursor of  $(C_6H_8)Ru(CO)_3$  (a carbonyl) that is dissolved in hexane and fed to a CVD chamber. See examples I-II (col. 7)

Claim 14 Hexane vaporizes at a higher temperature than carbonyl organometalics such as  $(C_6H_8)Ru(CO)_3$ .

Claim 15 Hexane is a C6 alkane

Claims 16-22 "no more than" includes zero. Thus, claim 16 includes both mixtures having an additive and those that have no additive

Claims 24-26, 28-32 CVD is used to deposit the precursor. The co-reactant is not required by the claims. Nevertheless, Marsh teaches using co-reactants. (col. 6, ll. 29-37)

Claims 25, 40 The precursors are used in integrated circuit processing (col. 1, last paragraph). Additionally, the Ru layer can be used to make an interconnection trace, among other structures.

Claims 28, 30 Oxidizing agents are taught. (col. 6, ll. 29-37)

Claim 39 A semiconductor substrate can be used

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 41-54 and 56 are rejected under 35 U.S.C. 103(a) as being unpatentable over Vaartstra (U.S. Patent 6,225,237).

Marsh teaches the use of  $(C_6H_8)Ru(CO)_3$  (a carbonyl) that is dissolved in hexane in semiconductor processes as applied to claims 1, 2, 14-22, 24-26, 28-32 and 39-40 above, but lacks some of the devices required by claims 41-54 and 56. Marsh teaches that the use of this precursor composition eliminates the need to heat the feed (lines col. 4 II. 23-35).

Claims 41-48 Vaartstra teaches a capacitor (Fig. 1) having a bottom electrode (13), a dielectric layer (11), a top electrode (12). Claim 42 The dielectric barrier is optional. Claim 43 The dielectric is ferroelectric Claim 44 The plug appears to be optional Claim 45 The conductive barrier is optional Claim 46 The bottom electrode can be Pt Claim 47 The dielectric can be Ba, Sr, Ti type materials (col. 3, II. 43-48) Claim 48 The top electrode can be Pt.

Claims 49-52 Vaartstra teaches a wiring structure comprising etched trenches in a dielectric layer (28) and wiring material (38). Claim 50 The dielectric (28) is oxide Claim 51 The barrier is optional, see claim 49 Claim 52 The wiring material can be Ti

Claims 53-54 and 56 Vaartstra teaches a substrate (16) having a source (20) and drain (22) with a channel therebetween, a gate dielectric (silicon dioxide 26), and a gate electrode (24), the precursor is applied to form layer 24. Claim 54 The gate insulator is silicon dioxide Claim 56 The gate electrode is Ti

It would have been obvious to one having ordinary skill in the art at the time the invention to utilize the precursors taught by Marsh in the well known semiconductor structures taught by Vaartstra. One of ordinary skill in the art would have been

motivated to so by Marsh's teaching that this precursor has various advantages such as the fact that the feed lines do not need to be heated.

Claims 27 and 33-38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gadgil (U.S. Patent 5,879,459).

Marsh teaches a ruthenium precursor that is dissolved in hexane, but does not teach that precursor used in atomic layer deposition.

Gadgil teaches a pulse pattern for depositing an AB type material from precursor gases Ax and By respectively. See Figs. 1b-1b. One cycle incorporates one pulse of Ax and one pulse of By, each precursor pulse separated by a pulse of purge gas. Col. 3, ll. 29-37. This sequence avoids reactions between the precursors. Col. 3, ll 50-55.

It would have been obvious to one having ordinary skill in the art at the time the invention to pulse the ruthenium precursor of Marsh because this configuration avoids gas phase reaction as taught by Gadgil.

Claim 55 is rejected under 35 U.S.C. 103(a) as being unpatentable over Marsh and Vaartstra as applied to claims 1,2, 14-22, 24-32, 39-54 and 56 above, further in view of Bryant (U.S. Patent 5,668,028).

Marsh and Vaartstra teach a precursor mixture and forming a gate dielectric (26, Fig. 2) made of silicon dioxide. Claim 55 requires a gate dielectric composed of more than one layer.

Bryant teaches a gate oxide layer having a thin nitride layer overlying the oxide layer just under the gate conductor. The nitride layer prevents asperities on the underside of the gat conductor during reoxidation of the transistor.

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It would have been obvious to one having ordinary skill in the art at the time of the invention to use a two-layer NO gate insulating layer in the device taught by Vaartstra to reduce the formation of asperities on the underside of the gate conductor as taught by Bryant.

### ***Response to Arguments***

Applicant's arguments with respect to claims 1,2, 14-22 and 24-57 have been considered but are moot in view of the new ground(s) of rejection.

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kiesha L. Rose whose telephone number is 571-272-1844. The examiner can normally be reached on M-F 8:30-6:00 off 2nd Mondays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on 571-272-1852. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

  
KLR

  
**AMIR ZARABIAN**  
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